



Quality Assurance Report
RICH FM Reflector
Serial Number FM-00102

The following defines quality control procedures adopted for the fabrication of the RICH FM Mirror and Flight Spares for the AMS-02. Standard CFRP composites handling procedures were used throughout the entire fabrication process. Material handling procedures are defined here as well.

Material Handling

Storage

The CFRP materials used were specified by the manufacturer to be stored at or below freezing temperatures when being stored. This was achieved by way of chest type freezers maintained at CMA.

Temperature and Humidity

Before use, the material was thawed at room temperature for at least 2 hours before the bag containing the material was opened. This was done to prevent water vapor from condensing on the surface of the prepreg material during thaw. As cyanate materials are sensitive to water vapor, the humidity of the room was monitored for relative humidity and temperature at all times. The assembly room is kept under air conditioning to maintain the relative humidity below a certain level of 40%. The temperature of the room is always kept to between 20 and 25°C.

Cleanliness

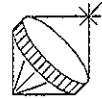
When cutting the material, it is recommended that the surface of the material be kept clean from debris that could be trapped between layers of material during lay-up. For this reason, the cutting table was periodically checked for cuttings of carbon fibers or any other debris, which could cause contamination.

Handling

It is also recommended that the CFRP material not be touched by hands to excess. Although it is not required by the manufacturer to always wear gloves during the cutting and lay-up processes, gloves were worn by the technicians to avoid excessive contact by hands. This was done for safety reasons as well as for contamination abatement.

Lay-Up Accuracy

The material is required by the manufacturer to be stored at freezing temperatures when not in use. For this reason, the material was cut and laid-up immediately to avoid undue moisture uptake and possible drying of the material. It is best to maintain enough tack in the material so that adequate adhesion between plies is maintained during the lay-up process. This ensures that no slippage between plies occurs, which could lead to ply misalignment of the part. Lay-up accuracy is essential for maintaining the figure of the part as it is produced over the mandrel.



Vacuum Process

Bagging

Once lay-up of the mirror substrate is achieved, the laminate was vacuum bagged for consolidation pressure and heating according to the manufacturers recommended specifications for cure. This is an industry standard. A standard peel ply was used to ensure that the part does not adhere itself to the bagging and bleeder material. The laminates were also placed on an adhesive peel-ply material used as a release barrier from the mandrel. The release films were purchased from a composites supply house and are current industry stands for this procedure

A standard bleeder cloth or breather cloth was used to create the air path through which the volatile materials from the cure cycle are release from the laminate. These include also water vapor and other contaminants. The recommended amount for this lay-up is a single ply of bleeder cloth and that amount was used for the consolidation of each of the mirror substrates.

A flexible vacuum bagging material was used to contain the vacuum of the part during cure. Used was a flexibly nylon material, which is rated to handle temperatures of up to 177°C. The recommended cure temperature of the cyanate ester material is 121°C, which is well within the operating range of the bagging material.

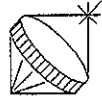
Curing Process

The recommended cure temperature of the cyanate ester material is 121°C. This cure temperature was used to produce all of the mirror substrates for the FM and Flight Spares. The curing process occurred in CMA's 2-meter diameter furnace. The furnace is insulated with 150mm thick Al_2O_3 felt insulation and is extremely well insulated. The temperature is achieved by way of resistance heating wires in the furnace, which are placed to obtain a high degree of temperature uniformity.

The furnace ramps to temperature of 121°C, under full power, at 2-3°C/minute, which is within the manufacturers specification 3°C to 5°C/minute for adequate cure. Once the cure temperature was achieved, it was maintained for more than 12 hours, which is 4 times the manufacturers recommended cure time for adequate cure. It is beneficial to exceed the 3-hour cure time as it will increase the level of cure for the laminate ensuring stability of the laminate.

Trimming the Segment

After curing the Carbon Fiber, CF, segment, a final trimming process was imparted to the CF segment. Tungsten Carbide and silicon carbide grinding points were used to remove excess material from the CF segment. These tools are industry standard for this type of trimming.



Structural Reinforcements, Vertical Ribs and Flanges

Vertical Ribs

All vertical ribs were produced using a molding process. The mold was treated with Releaseal 30 release agent from Airtech, which is an industry standard. Standard consolidation pressures for the CF material was applied using caul plates and clamps. The parts were placed in an oven heated to 121°C for the manufacturers recommended cure time and ramp schedule.

After cure, the vertical ribs were trimmed to the final shape using a diamond saw.

Top and Bottom Flanges

The flange segments, both top and bottom, were produced as plate elements and pressed in a laminating press to 65 psi. according to the manufacturers recommended cure time and schedule.

Final trimming of each flange segment was performed using computer numerical control, CNC. The cutting tools are tungsten carbide cutters.

Gluing Components with 1210 A/B Adhesive

Preparation of all components glued with 1210 A/B adhesive were consistent with the manufacturers recommendations. The parts were abraded with Emory paper, #220, and cleaned thoroughly with commercial grade Acetone until no visible carbon fiber dust was visible.